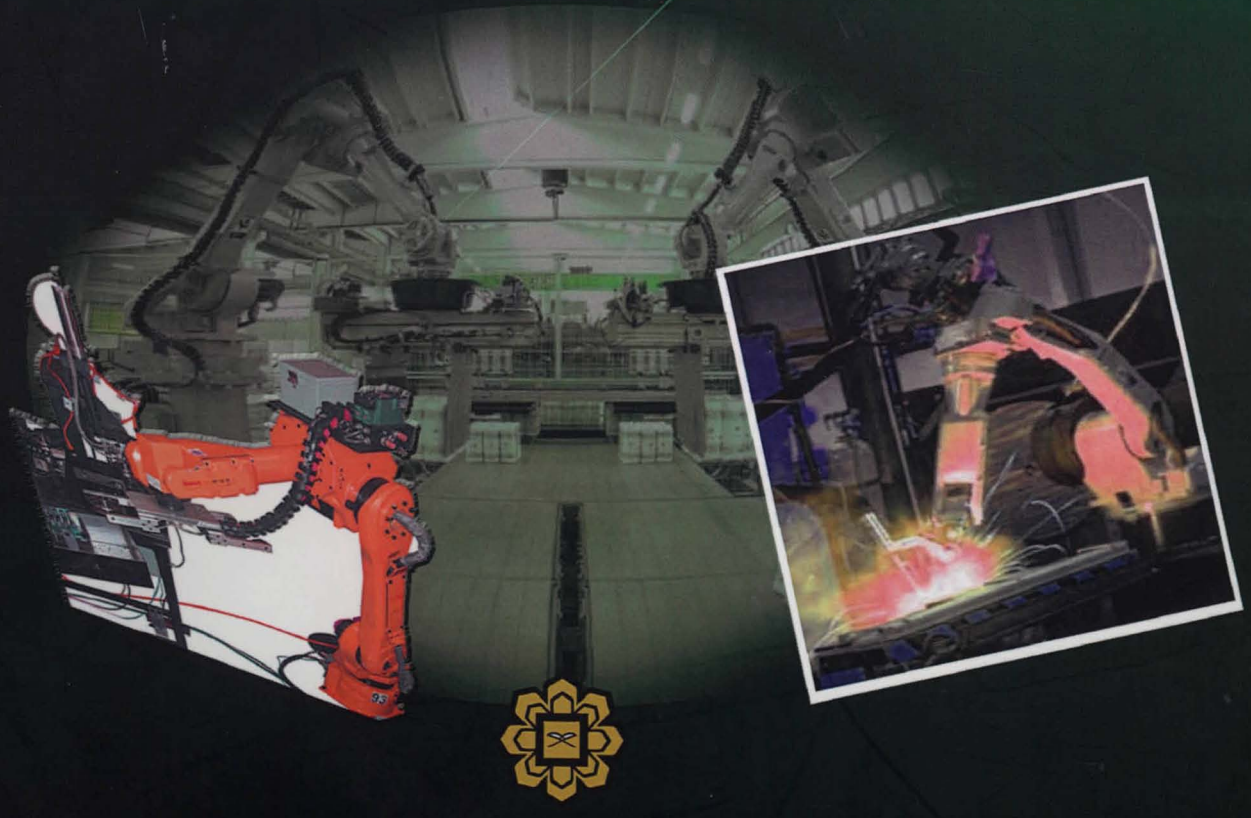
MECHATRONICS BOOK SERIES

ROBOTICS AND AUTOMATION

Rini Akmeliawati
Wahju Sediono
Nahrul Khair Alang Md. Rashid



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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Editors

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IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Rini Akmeliawati, Wahju Sediono & Nahrul Khair Alang Md. Rashid: Mechatronics Book Series Robotics and Automation

ISBN: 978-967-418-152-9

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

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CHAPTER 17

Autonomous Unicycle Robot Using Reaction Wheel Pendulum: Controller Design

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17.1 Introduction

As the robot moves it starts to stabilize itself. Then, it will move forward and backward. Once the robot detects the tilting angle, the reaction wheel will rotate the disk to maintain it upright position. The drive wheel moves forward and backward because it wants to balance the robot when the robot is moving [1].

Unicycle using reaction wheel pendulum is like human riding a unicycle. A person on a unicycle is like the drive wheel that maintains longitudinal stability by pedaling faster or slower, by leaning his torso forward or backward and by moving his arms forward and backward [2]. Lateral stability is obtained by leaning his torso sideways just like the reaction disc, pulling an arm in or stretching it out and by steering the wheel into the direction that he is falling by twisting motion at the hip joint [3].

17.2 Operational Sequence

The system operational sequence is summarized in flowchart in Fig. 1 below. The operation is divided into two parts since the system has control two parts the lateral balance and also full balance.

Based on the Fig. 1, the system is started when the button is pushed; the reaction disc from the robot will rotate to try balance the system. It will go through the IMU sensor which is accelerometer and gyroscope to detect the angle of unbalance position. Then, the sensor sends the signal to microcontroller and it will figure out the angle is at left or at right. The PIC16F877a then will tell the motor to rotate either in clockwise or counterclockwise. If it unbalance towards the left, the motor will rotate clockwise and if the robot is unbalance towards the right, the motor will rotate counterclockwise. The systems continue to operate this way till the user clicks the stop button.

17.3 Hardware and Electronics Components

The robot use the following part:

1. DC Micromotors 3863H024C
2. PIC 16F877A
3. IMU 5 degrees of freedom IDG300/ADXL330
4. Lithium Polymer Rechargeable Battery, LIP-11.1-2200
5. 2 Motor Driver MD30B